Next steps for *b*-jet tagging simulations

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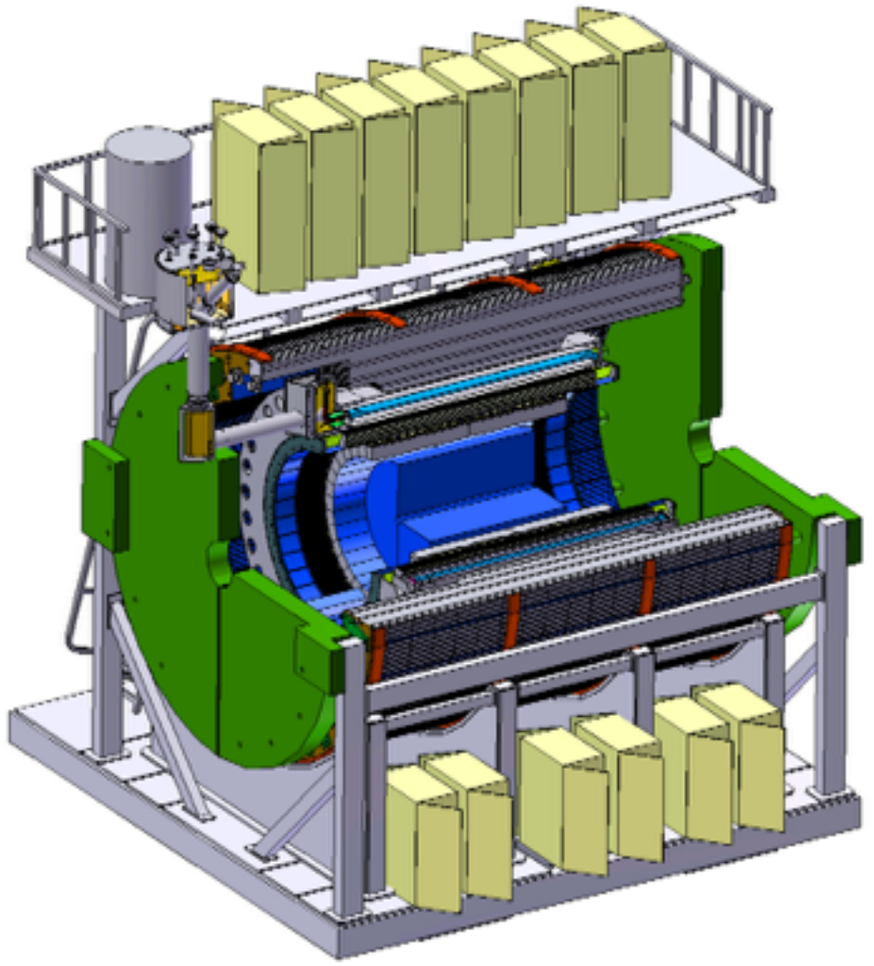

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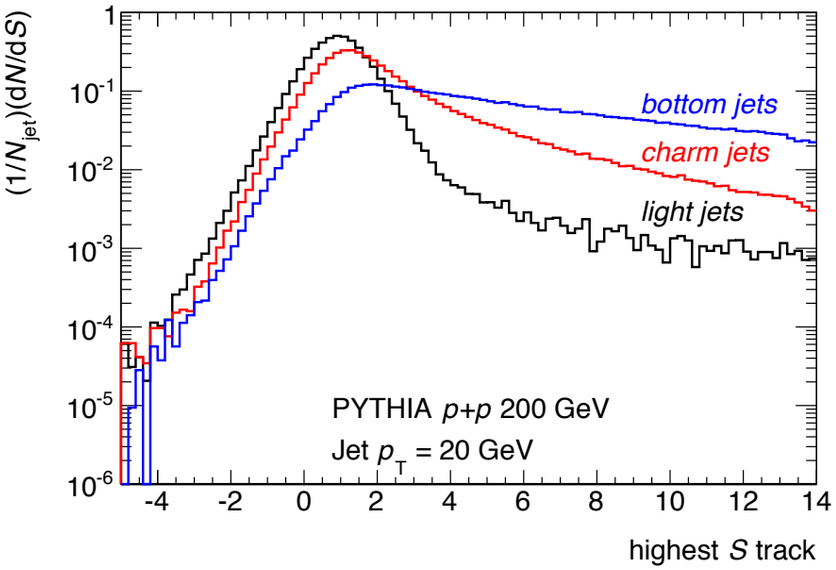
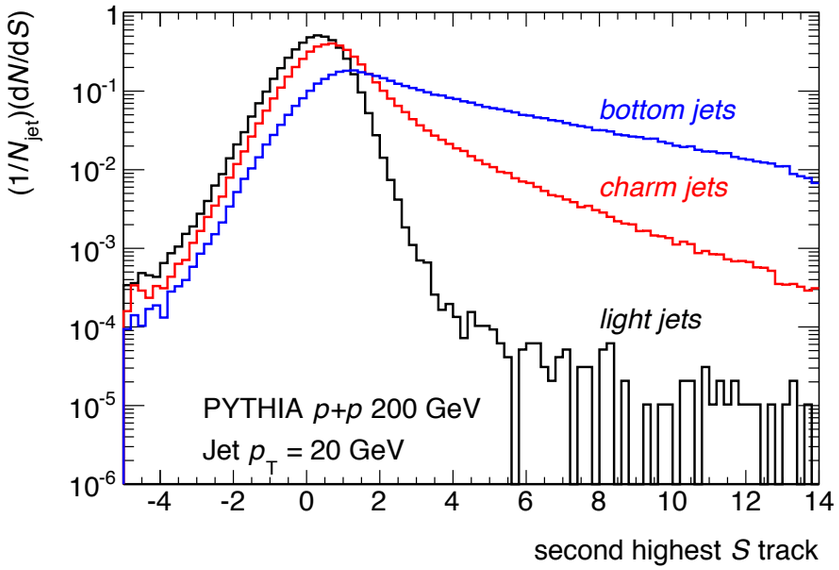
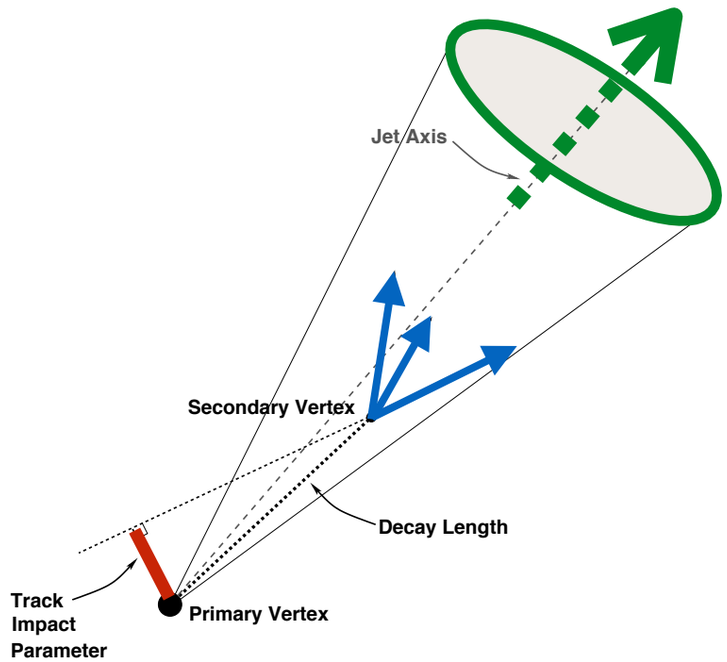
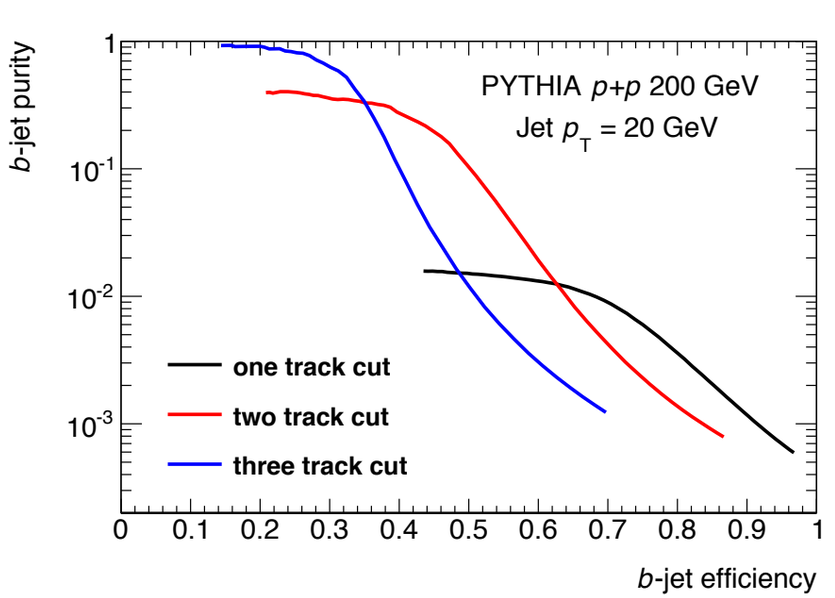
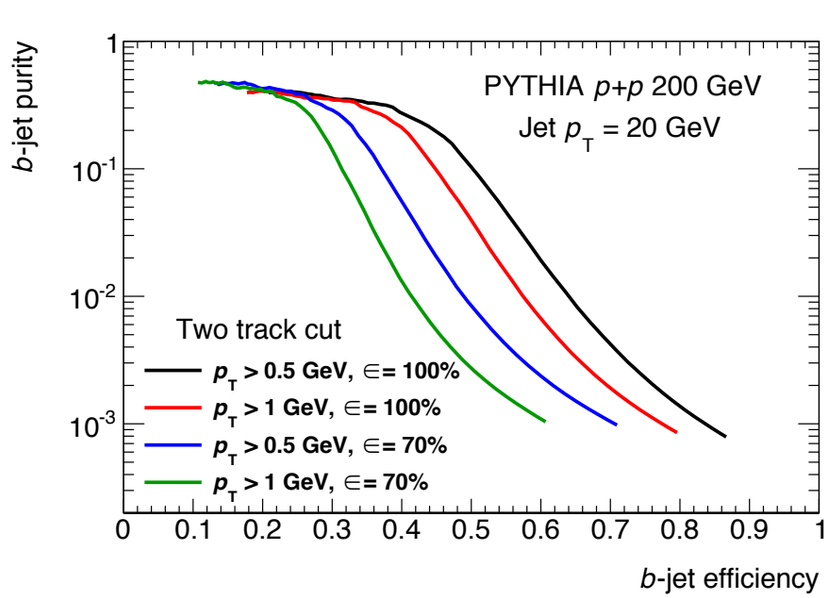
b-jet tagging in MIE Proposal

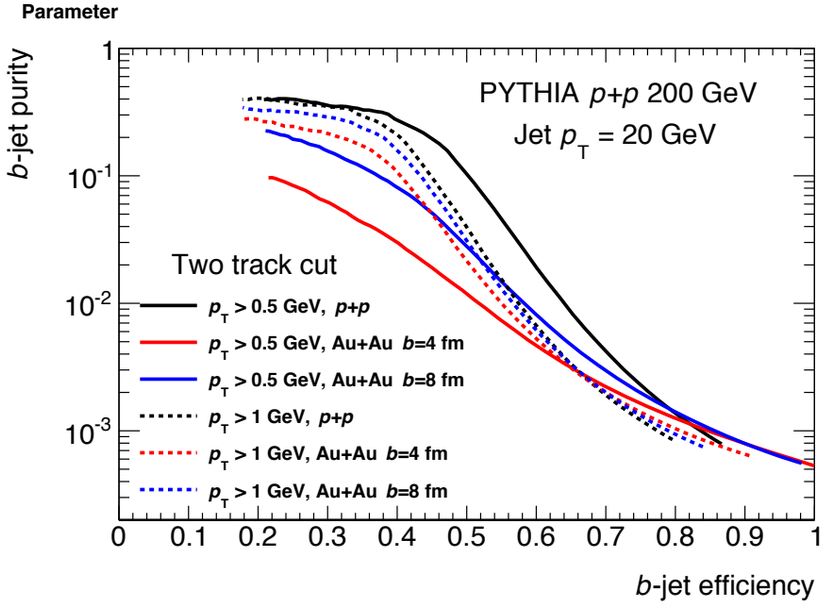








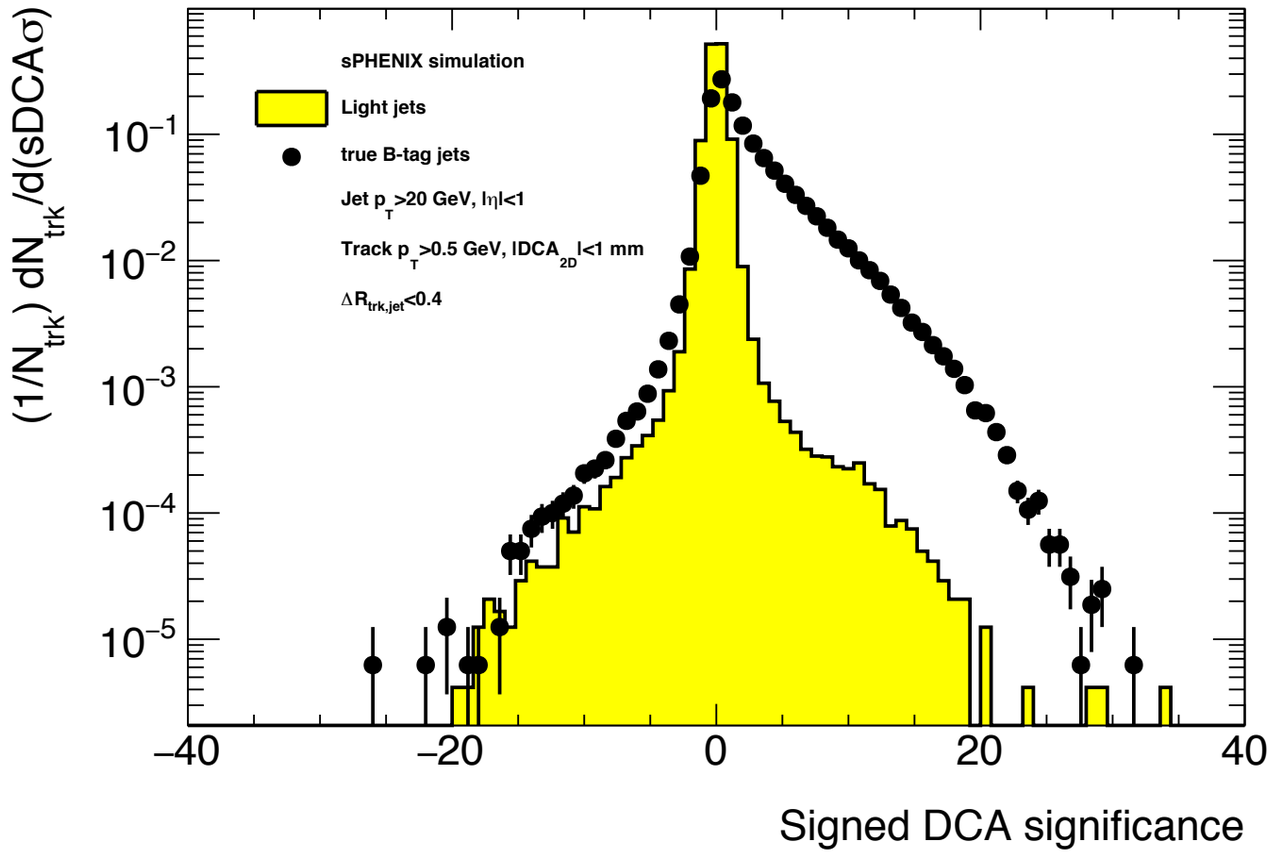




- Fast simulation studies, “Track Counting” algorithm with Ref (e.g. silicon) tracking, simple simulation of Au+Au UE
- p_T = 20 GeV jets, focus on *b*-jet efficiency vs. *b*-jet purity

Full G4 simulations

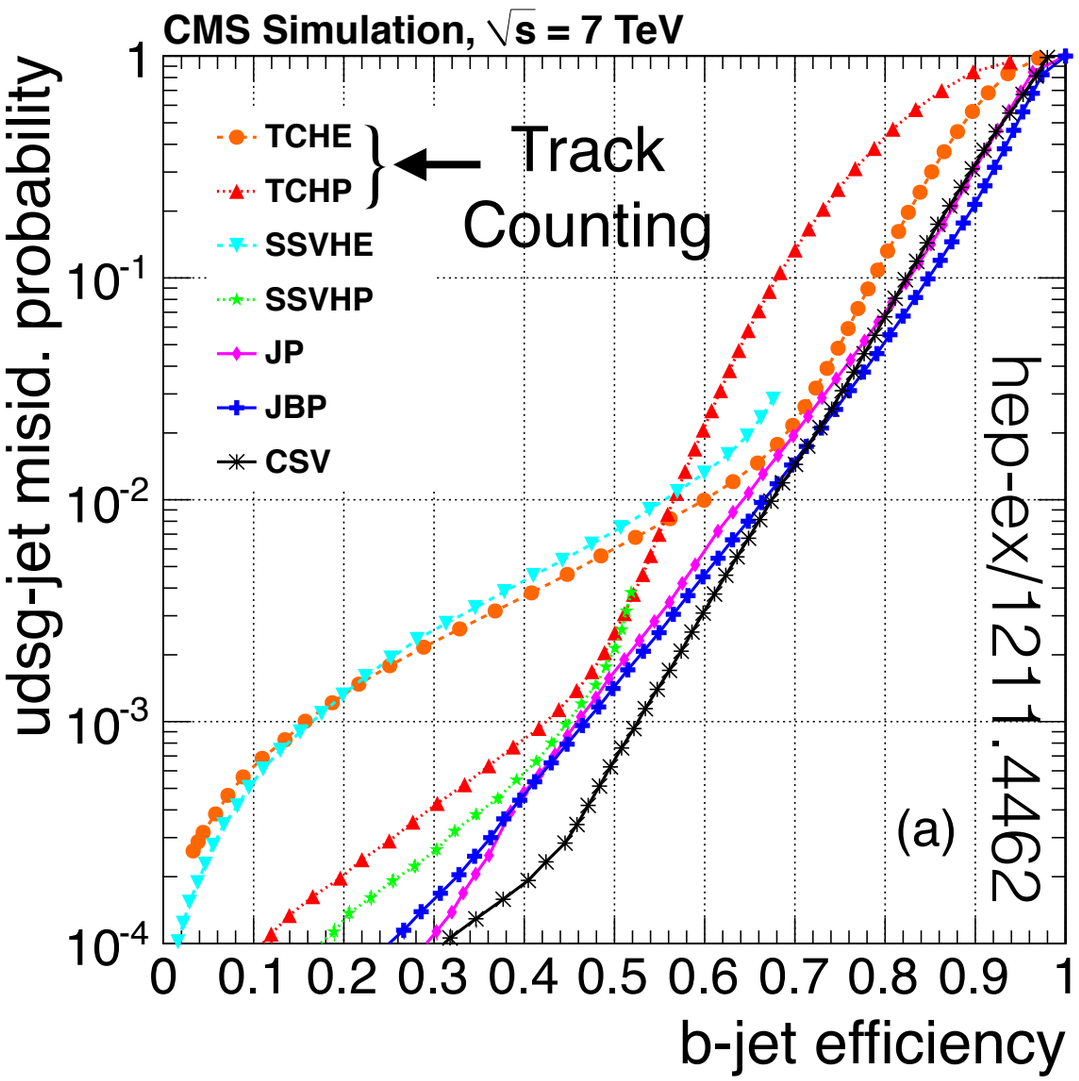
- Full G4 simulation of *p*+*p* collisions started by P. Steinberg
  - ➡ to demonstrate that large-DCA tails persist in full simulation
  - ➡ however, not yet at a stage where we could repeat full performance study



- Ideally, *b*-jet tagging simulations should go hand in hand with evolution of tracking simulations
  - ➡ so that performance can inform design choices
  - ➡ need “standard” set of performance metrics (e.g. *E* vs *P* curves) which can be generated for each iterations of a configuration?

Developing new taggers

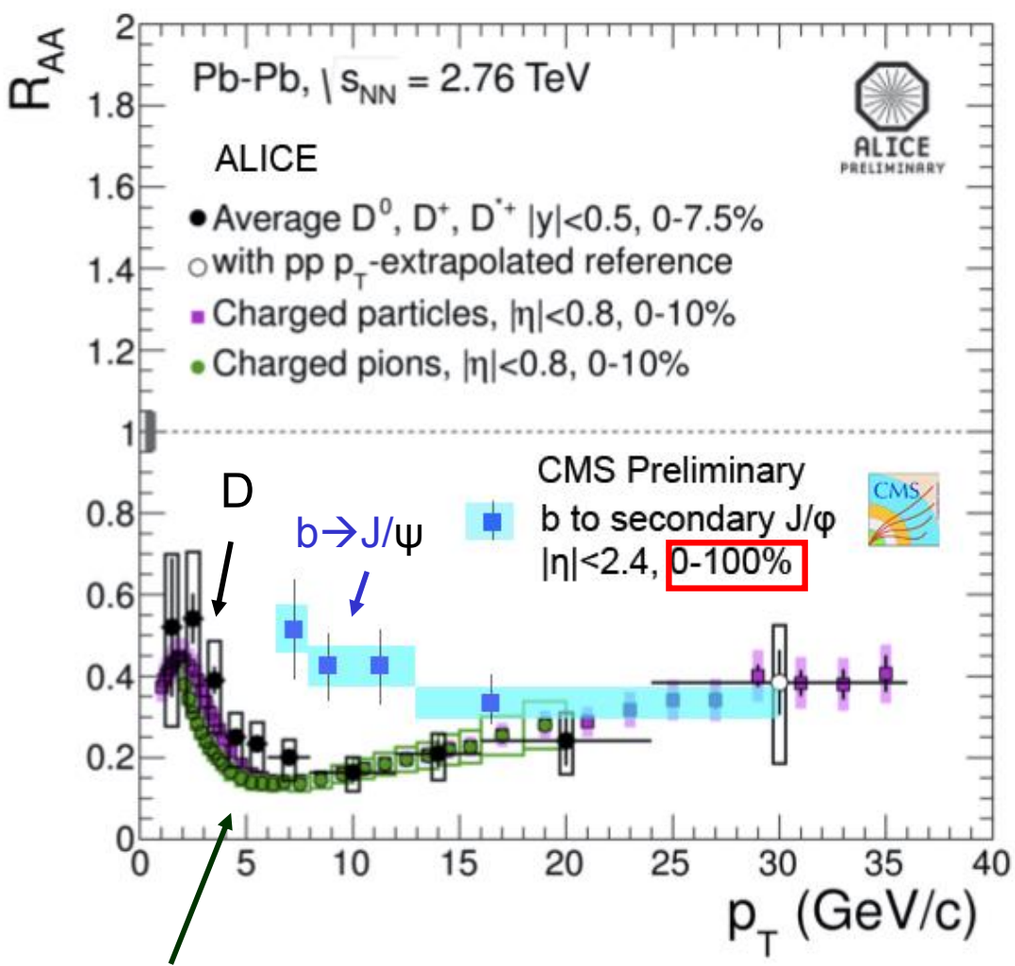
- MIE proposal benchmarked "Track Counting" algorithm:
  - ➡ preferential selection on *b*-jets based on presence of tracks with large DCA significance

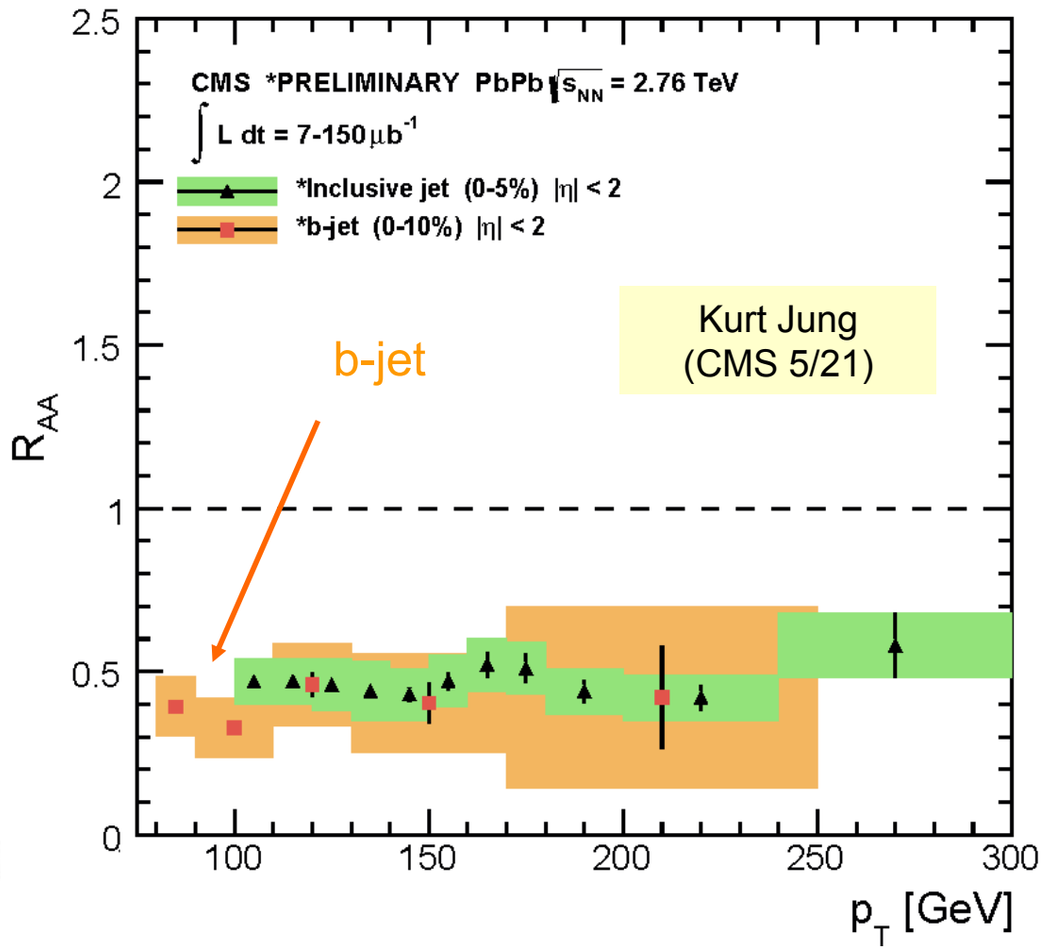


- A robust *b*-jet program must explore other methods:
  1. "soft lepton tagging": require nearby electron w/ large p_T^{rel}
     - ➡ initial studies were favorable, ties into $e^{\pm}$ ID used for Upsilon physics
  2. direct secondary vertex reconstruction
     - ➡ initial exploration by Peter Steinberg, but more work needed
- "Orthogonal" tagging methods stressed as strong positive by Yen-Jie Lee (CMS *b*-jet tagging in Pb+Pb expert)

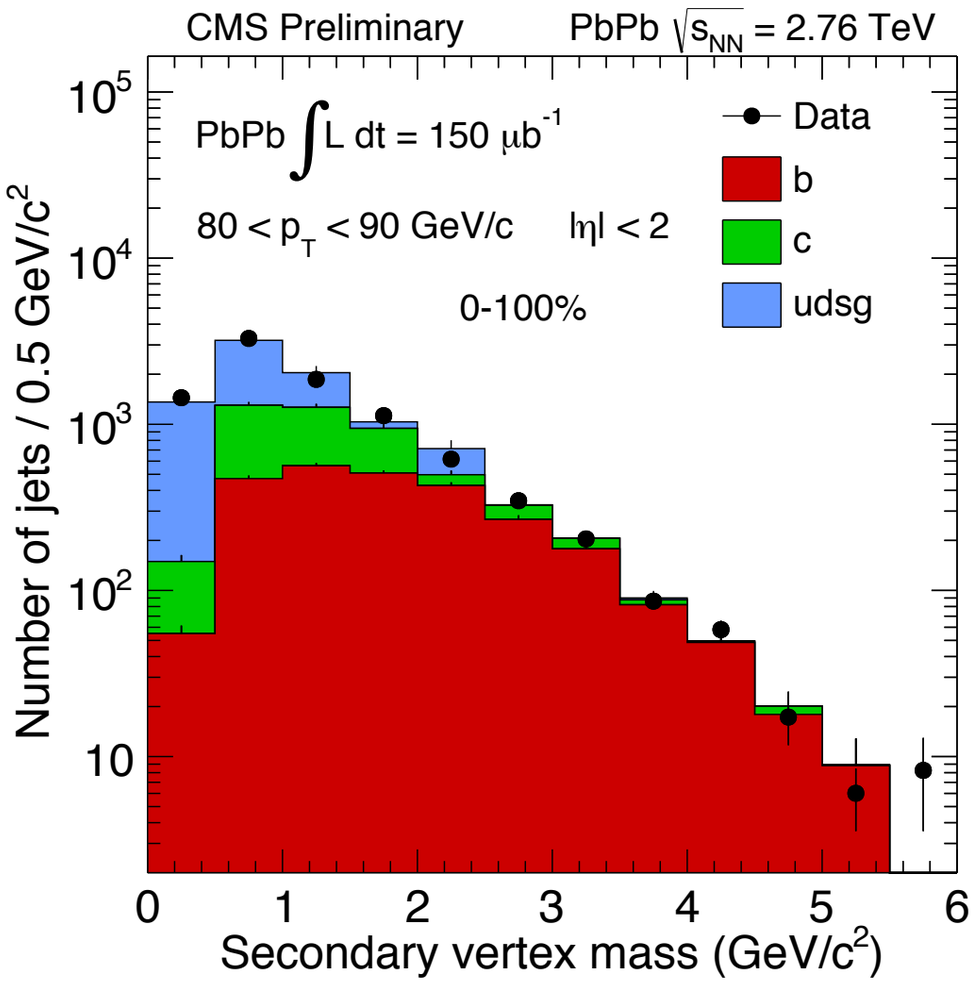
Tagging systematics: p_T

- DOE Review Committee and LAJUDR workshop attendees stressed need for low-p_T reach to probe mass dependence of quenching
  - ➡ at EPS-HEP, Yue Shi Lai (CMS) indicated low p_T performance was an important issue for *b*-jet tagging in LHC Run 2
  - ➡ currently, no constraint on p_T^{jet}-dependence of tagging performance… (very important, initial studies may not need G4)





Tagging systematics: *b*/*c*/light



- Experts also stressed importance of performing template fits to discriminating observables, instead of just cutting on them
  - ➡ e.g. CMS *b*-jet result fit to SV mass distribution, ATLAS exploring template fits to p_T^{rel}
  - ➡ allows extraction of *light*/*c*-/*b*- jet contributions separately

b-jets: jet performance

- MIE proposal document explored performance for inclusive jets (energy scale closure, resolution, fake-free kinematic range w/ and w/o FJR, etc.)

  ➡ importantly, these may be different for *b*-jets

1. With calorimeter-based measurement, average response for *b*-jets will be different than gluon jets and (maybe?) different than light quark jets

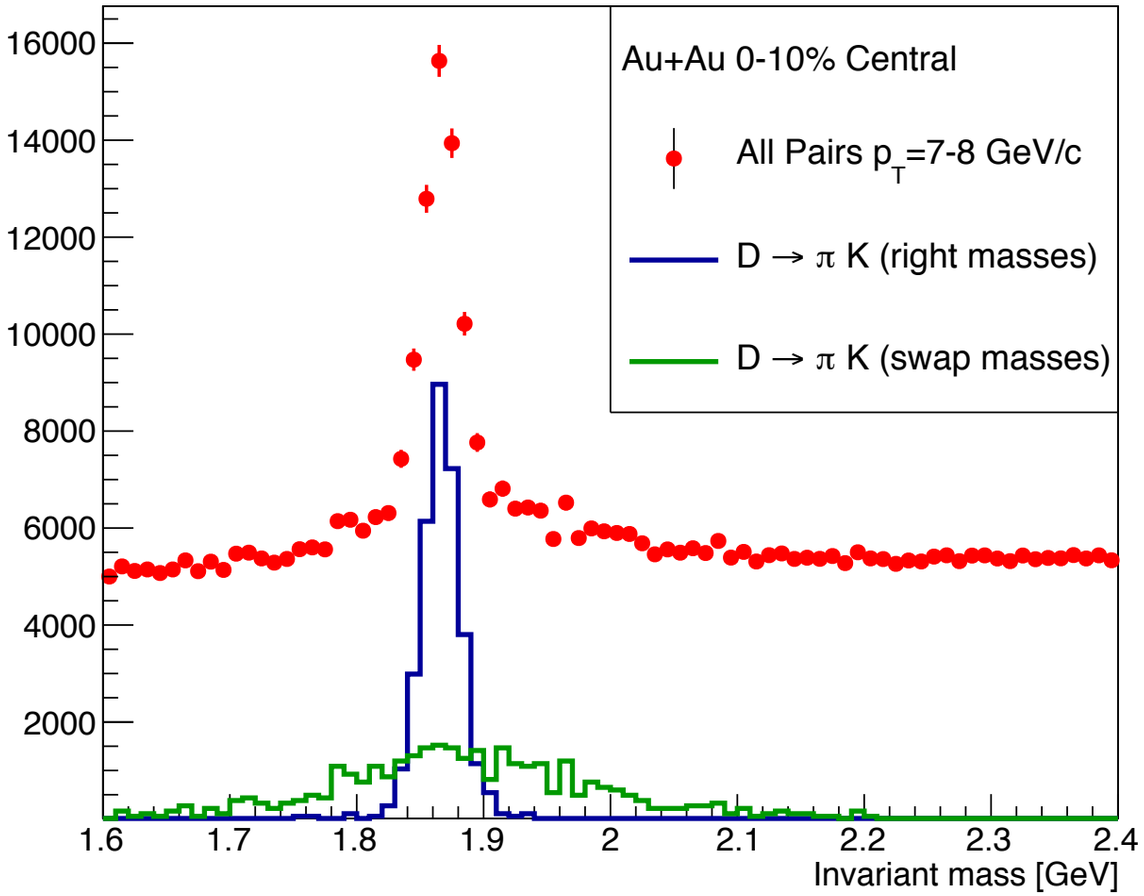
   ➡ LHC experiments derive separate calibrations for channels with different flavor fractions, e.g. γ-jet

2. FJR efficiency probably dramatically different for (hard-fragmenting, high-multiplicity) *b*-jets

   ➡ important limitation on low-p_T reach

- We have very little constraining information about these issues at the moment…

D and *B* meson reconstruction



- DOE Committee excited by the HF meson reconstruction capability
  - ➡ enabled by precision tracking
- Report stressed that this part of the program could be developed more
  - ➡ the scientific motivation and the technical feasibility studies

- Example topics along these lines:
  - ➡ how well can we reconstruct HF mesons inside tagged *b*-jets? (e.g. where combinatoric background is smaller)
  - ➡ are there observables for which jet quenching MCs predict large modifications? (e.g. modified charm FF, $D^{c->D0}(z)$)
  - ➡ what is the physics impact of *D*/*B*-photon or *D*/*B*-jet correlations?
- This topic is wide open at the moment…

b-jet topics for workfest

- Many possible ways to proceed from initial MIE proposal document / DOE Review work:
    1. full G4 simulations with both tracking configurations
    2. soft lepton tagging and secondary vertex reconstruction
    3. p_T-dependent performance and template fitting
    4. jet performance for *b*-jets
    5. HF meson reconstruction and physics
- We should define which are most important, and what the necessary timescales are.
- Can we organize manpower & define tasks at this workfest?